

Resource- and Population Monotonicity in Cake-Cutting

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Abstract

A village is built near the sea shore and its farm lands are divided fairly among the founders. In time, the village grows in area and the lands are re-divided. Can we guarantee that all villagers gain from the growth, or at least not lose? Some time later, a few villagers leave the village and their lands become free for re-division. Can we guarantee that all remaining villagers gain from this re-division, or at least not lose? These two questions motivate the so called resource monotonicity (RM) and population monotonicity (PM) axioms. Resource monotonicity, also known as aggregate monotonicity, requires that when new resources are added, and the same division rule is used consistently, the welfare of the participants should weakly increase. Population monotonicity is concerned with changes in the number of participants. No one should profit from the arrival of a new agent, when more people share the same resource, and everyone should be weakly better off if someone leaves. We study the two monotonicity requirements in the framework of the classic fair cake-cutting problem, where a single heterogeneous resource - such as land or time - has to be divided fairly. Cake-cutting protocols can be applied in inheritance cases and divorce settlements. They can be also used to divide broadcast time of advertisements and priority access time for costumers of an Internet service provider.